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by means of an epicentrum, in the original meaning of the word, may be retained. In all other cases the term can now be used only in a conventional way to designate the region of the origin of the disturbance.

In his own treatment of the questions involved the author strictly adheres to the method of his earlier work, namely, of placing observations foremost and deducting his conclusions from them: "Les théories passent, les observations restent." In this way he takes up, after an historical introduction, first, the study of macroseisms or "direct seismological observations." He discusses the accepted facts and theories of intensity, direction, epicentrum and focus, tremors, seismic noises, marine quakes, and relations of earthquakes to other natural phenomena. The second part, on microseisms or "instrumental seismology," compares the merits of the various seismographs, of seismogrammic records, the relations of the seismic movement to the interior of the globe, and the character of the microseismic movement. The megaseisms, or "applied seismology," constitute the third part, and here the author discusses the geological effects of earthquakes, the action of earthquakes on the different building materials, and earthquake-proof architecture. By a comparative study of the works of the leading specialists on each of these numerous subjects, in the light of his own comprehensive material and experience, the author has given a perfect presentation of the present status of this science, emphasizing over and over again the need for more and trustworthy observations as a foundation for further wholesome progress, and asking for a critical revision of a number of theories sanctioned by scientific tradition, for which unquestionable proof has not yet been furnished and which, upon re-examination, might be found to be as fallacious as was the theory of the epicentrum.

In this way the book combines the three distinctive merits of a catalogue of the most important earthquakes, a reference work on seismic literature in all its branches, and a perfect cyclopedia of seismology as a science. Whoever is going to take up work along any of its lines will find in it, not only all that has been done before, but also an abundance of suggestions as to the direction in which his efforts may prove most successful. Certainly, after the publication of this volume, France can no longer be accused of not having contributed her share toward the promotion of seismic studies. M. K. G.

The Geology of the Cromwell Subdivision, Western Otago Division. Bulletin No. 5 (New Series). By James Park, New Zealand Geological Survey, Department of Mines, Wellington, New Zealand, 1908. Pp. viii+92. 20 plates, 10 maps, 6 geological sections, and an index.

The continuance of the excellent work of the New Zealand Geological Survey is expressed in the prompt appearance of new reports dealing with additional areas of that remarkable country. Geologists and geographers have come to expect these reports with an unusual degree of interest, stimulated, no doubt, by the extraordinary variety of land forms and geological structures and conditions which the islands exhibit. New Zealand is indeed a fairly complete epitome of the world's geological and physiographical features and affords a range of phenomena but rarely exceeded by any land area of equal size.

The report before us deals with part of the Western Otago Division in the south central portion of the South Island. The most conspicuous physiographic feature of Central Otago is the now uplifted and partially dissected peneplain or base-level of erosion, the extent of which is indicated by the numerous parallel and transverse table-topped ranges that occupy the region. The mountain ranges, under various names, are merely undissected remnants of a once continuous peneplain and have gained their fragmental character from the profound gorges cut by the streams of the region since its uplift. About the headwaters of these streams it is still possible, by making long detours, to ride from range to range upon the yet undissected and flat summits of the "mountains." The peneplain was formed upon a Paleozoic mica-schist, of which there are two distinct series. The base-levelled surface coincides in many notable and, indeed, remarkable cases with the plane of foliation of the schist, but the correspondence is not universal. In three of the ranges no relation whatever exists between the plane of erosion and the planes of schistosity. The once truly base-levelled character of the country is in no way more clearly indicated than in this occasional lack of correspondence between surface and structure, where the plane of the surface is a continuation of one in which sympathy between surface and structure might lead to other conclusions.

East of the Central Otago peneplain is the great Barewood "plateau of erosion," by which is meant a now uplifted peneplain dissected by streams occupying numerous narrow gorges and ravines. Over the greater part of this plateau the mica-schist lies almost perfectly horizontal. What relation exists between these two ultimate surfaces of erosion, the Central Otago peneplain and the Barewood plateau, has not been determined, but the author is inclined to view them as faulted portions of the same original plain, the uplift by which their plateau and mountain character were gained in the present cycle differing in degree but not in kind. The profound valleys of the Central Otago peneplain are narrow and excavated by the continued action of ancient glaciers and present-day rivers. Besides these valleys, there are various basins which are *graben* or faulted depressions. The latter occupy about 45 per cent. of the original area of the peneplain. In them were laid fresh-water deposits having a thickness in places of over 1,000 feet. The period of deposition covered, probably, the whole of the Pliocene. Certain thin beds of marine shells in one of the basins indicate that the sea had access to the basin about the close of the Miocene or the beginning of the Pliocene. The flat undissected and unfaulted portions of the peneplain are covered with a thin veneer of quartz gravel, rounded or subangular, and often scattered through the loamy, peaty soil that covers the greater part of the surface.

The presence of "rock-pillars and knobs" is noted, residuals surviving the general base-leveling effects of the previous cycle of erosion. They are not, however, marked by superior hardness, and their relative immunity from degradation is referred to some accident of situation or direction of jointage. They are found where the schists lie more or less horizontally.

One of the most interesting phases of the report is the detailed study of the relation of the mountain ranges and the lake basins. It is concluded that the lake basins are *graben,* or strips of subsidence, and the flat-topped ranges are posts or blocks left standing at the level attained by the peneplain in the initial stages of the present cycle. Special study is given to the Cromwell basin. It is shown that the draining stream emerges from the basin 3 miles from the southern end. It is argued that if the basin were due to normal stream erosion the basin or valley trend and the trend of the stream would be coincident. If the basin were due to an upwave across the path of the stream the base of the sediments should be coarse and gravelly in contrast to their actual fine character as observed in good exposures that reveal the basal members of the series. Ice erosion cannot be invoked as an agent of stream disorganisation, for the beds are Miocene and Pliocene, and the New Zealand fauna and flora for these periods require a warm or at least a temperate climate.

It may be pointed out, however, that no adequate consideration is given to the possibility that the fine sediments at the base of the series, assumed to be lacustrine, are the deeply weathered and fine material of the surface of the peneplain swept into the down-warped or down-faulted areas by the streams as the first consequence of uplift and the redistribution of land waste. In the United States some of the fine Cretaceous and Tertiary material is now quite generally considered as the last product of streams draining the Jurassic and Cretaceous peneplain before the uplift or the first product of stream erosion after uplift. The overflow of this mountain-girt basin is cut in solid rock and we fancy this fact is given more weight than it deserves. It is quite possible (and this argument seems to have been omitted from the report) that the filling of such a basin, continuing *pari passu* with the faulting, might from the first maintain a river plain, and that the even bedding is but an expression of the delicate balance maintained between a grading stream and down faulting basin floor. Such a delicate balance may well be temporarily destroyed by excessive down faulting and a lake basin formed, but there is no compulsion in the acceptance of this view so far as we can understand the evidence presented. As a further objection it may be stated that no explanation is given of the present course of the outlet. If a lake basin once existed, its outlet must have been functioned in late—lake time: (a) by faulting, or (b) by capture from an extra border region, or (c) by overflow in a location determined by some sag of the basin margin. None of these possibilities is considered. It is merely stated that the lake basin "existed long before the river found its way into it." The reviewer believes that data for the answer to these objections are in the hands of the author, and would with others cordially welcome further elucidation as a matter of wide current interest and lasting importance.

Of exceptional interest to geographers in each of the New Zealand reports in the New Series are the geographic descriptions pertaining to conditions of human habitability and to the distribution of the native fauna and flora in response to physical conditions. In the present report it is indicated that the main plateau area, called the Cromwell Flat, a tract 4,000 to 5,000 acres in extent, possesses a light but rich soil that cannot be brought under cultivation without artificial irrigation. Toward the northwest along the foothills that limit the Flat in this direction and mark the change to the upper base-leveled surface, there is a string of prosperous irrigation farms. The soil is here no richer than on the flat land below, but its situation at the foot of the range makes irrigation possible from the mountain streams. The majority of the valleys are little better than steep gorges or rocky defiles sharply incised below the level of the uplifted peneplain. The valley floors stand about 1,000 feet above the sea; the uplands range in height from 4,000 to 7,600 feet. The valley flats, terraces and foothills are bare and thirsty, except where irrigated; the uplands, better provided with moisture, are well covered with native grasses and subalpine vegetation and provide excellent pasturage for sheep even in midsummer. This contrast between valley bottom and upland is so marked that no adequate idea of the pastoral value of the country can be obtained along the road routes, as these in most cases follow the valley floors. The key to the distribution of moisture is found in the topography and the fact that the area lies in the belt of westerly winds. The higher ranges and uplands to the west intercept the moisture, and are themselves snow-covered, while the eastern plains and plateaux in the lee of the mountains experience excessively dry Foehn winds that dry up the struggling vegetation and parch the land. "The country in its natural state is quite destitute of trees and all forest vegetation." The steep slopes leading from valley bottom to plateau top are rugged and broken and supply innumerable places of shelter and refuge for the prolific rabbit, the scourge of the sheep farmer throughout Central Otago.

It seems ungrateful, in view of the many excellent features of this report, to object to matters of detail, but when these details affect an important principle the criticism appears to be justifiable. We cannot approve the first sentence in the chapter on physiography: "An elevated peneplain may be (a) an uplifted coastal plain; (b) an uplifted base-level formed in accordance with Powell's cycle of fluviatile erosion; or (c) a desert upland in an arid climate truncated by long-continued subaerial erosion in terms of Passarge's postulate." If this statement is based upon the conception that a peneplain means "almost a plain" as the etymology of the word indicates, and is used without regard to its mode of origin, we can understand the statement referred to, though many "almost plains" are not included in such a meagre classification. But this interpretation of the word is not correct. A condition more or less closely approaching the base-leveled one is the connotation of the word "peneplain"; as for a truncated desert upland, the word levelled as vs. base-levelled has been suggested (Davis: "The Geographical Cycle in an Arid Climate": *Jour. of Geology,* Vol. XIII, No. 5, July-August, 1905); and "an uplifted coastal plain" can in no sense of the word be called a peneplain unless it has been peneplained after uplift and again elevated. If it is argued that such a base-levelled coastal plain is described in the last paragraph of the section in which the statement is made, we are still at a loss to know why *all* land forms of youth or maturity that are subject to peneplaination were not included in the classification of what "an elevated peneplain *may* be." I. B.

A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet. By Col. S. G. Burrard, R.E., F.R.S., and H. H. Hayden, B. A., F.R.G. Four Parts. Geological Survey of India, Calcutta, 1907. (Price, 2 rupees each.)

The Geological Survey of India has published four papers under the above title. Col. Burrard, one of the authors, is Superintendent of the Trigonometrical Survey, and the other, H. H. Hayden, is Superintendent of the Geological Survey of India. Part I is devoted to "The High Peaks of Asia"; part II to "The Principal Mountain Ranges of Asia"; part III to "The Rivers of the Himalaya and Tibet"; part IV, "The Geology of the Himalaya," has not yet reached this Society. The parts, issued in quarto form, are illustrated with many charts and diagrams and a few other illustrations, and a great deal of information is compressed into tables.

These publications are very timely. Geographical and geological information has been accumulating for a century, and students are now in danger of losing their way in a mass of unclassified detail. These papers have, therefore, been prepared to co-ordinate the varied observations, to show how far geological and geographical